

**Statement of
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**before the
Committee on Commerce, Science and Transportation
United States Senate**

Mr. Chairman and Members of the Committee, thank you for this opportunity to appear today to discuss the status of NASA's Space Shuttle Return to Flight (RTF) effort. When the President visited NASA Headquarters on January 14, 2004, and announced the Vision for Space Exploration, he presented a bold and forward thinking vision that is affordable and achievable. He stated that the first order of business is to safely return the Space Shuttle to flight as soon as practicable, so that we can complete assembly of the International Space Station (ISS), focus Station research on supporting exploration goals, and fulfill the commitments to our International Partners. These are the first steps on the journey to fulfill the Vision for Space Exploration.

As the loss of Columbia and her crew reminded us, working in space is inherently risky. The Columbia Accident Investigation Board, ably led by Admiral Harold Gehman, recognized the risks associated with operating the Space Shuttle and made its recommendations consistent with an overriding safety objective. NASA recognizes these risks and is working to mitigate them, while moving forward to accomplish our missions.

Today's hearing provides an opportunity to focus on the two key elements in our progress to safely return the Space Shuttle to flight; (1) our cultural and organizational changes and (2) our technical solutions. The Gehman Report indicated that systemic cultural and organizational shortcomings contributed as much to the *Columbia* accident as any technical failure. NASA brought in outside experts to conduct an in-depth assessment and to identify areas where we can change our culture and organization to improve decision-making, risk management, and communications. Recommended changes have been progressively implemented, and we are pleased with the progress achieved through the efforts of the NASA Team. We understand that addressing these elements, along with fixing the technical issues that led to the Columbia accident are critical to improving our standards and performance.

Our decision-making and risk management processes have been enhanced through the establishment of the NASA Engineering and Safety Center (NESC) at Langley Research Center. The NESC's purpose is to provide independent technical expertise for

engineering, safety, and mission assurance to augment the capabilities inherent in NASA's programs. In addition, NASA began restructuring its engineering functions with particular focus on providing independent oversight of the technical work performed by the programs and improving technical standards. We are working through options to implement an Independent Technical Authority (ITA) for approval of waivers to technical standards and requirements. The Board recommendations urged that we develop a plan for ITA – we are seeking to implement the plan before Return to Flight. Within the Space Shuttle Program Office, NASA expanded the responsibility and authority of the Space Shuttle Systems Engineering and Integration Office to improve internal communications and coordination of technical issue resolution. The Space Shuttle program has added the NESC to formal boards and the Mission Management Team to assure a broader, independent evaluation of critical decisions. These are just a few examples of the numerous changes that are ongoing throughout the Space Shuttle Program and the Agency to strengthen our culture, improve how we are organized, and enhance our ability to perform our mission while focusing on safety first.

When we began developing our RTF plan, we understood the technical solutions to the challenges we faced would evolve over time. There were no predetermined answers coming out of the Board's recommendations, little prior experience to guide us, and no easy fixes. We put our best engineers on the job and our best managers in key positions to ensure that the Shuttle would be as safe as reasonably possible when it flew again. We have pursued multiple paths for some of the solutions in order to maintain our forward momentum. We have rescheduled the launch window several times to reflect achievement of milestones rather than have the schedule drive our planning. We have not allowed the budget to dictate the answer to any of the safety issues we faced. We have gone beyond the scope of the Board's recommendations to make changes and improvements to ensure our best efforts. All of this has cost more than the original estimate because at that time we could not identify the technical solutions needed.

Shortly after the Board issued its report, we issued *NASA's Implementation Plan for Space Shuttle Return to Flight and Beyond*, in September 2003. We announced that we would update the plan regularly to reflect on going development. On August 30, 2004, we issued the latest update, the sixth revision of the Plan. Throughout the past year these revisions report up-to-date status. This plan details the current tasks and cost estimates for RTF activities to safely return the Space Shuttle to flight. In addition to providing updates on NASA's progress towards RTF, the implementation plan recognizes the importance of RTF as the first step toward the long-term goals of exploration outlined in the Vision for Space Exploration. The updated implementation plan shows that NASA continues to make progress in all efforts to make the Shuttle safer. The revised schedule for implementing the Board's recommendations demonstrates that NASA has a deliberate approach for achieving all necessary milestones required to close each action item.

We have pursued our RTF plans in a purposeful manner, our progress has been steady, and we are optimistic that the launch of Discovery will occur during the window of opportunity in March through April next year. However, our RTF plans continue to be based on accomplishing milestones and are not driven by meeting a specific launch

window. Consistent with this approach, NASA will comply with all fifteen RTF recommendations from the Board prior to launch. The RTF Task Group, chaired by former astronauts Richard Covey and Thomas Stafford, is charged with assessing the implementation of these recommendations. The Task Group, as of July 22, 2004, has conditionally closed five RTF recommendations. Our current plan is to close the remaining ten RTF recommendations by the end of 2004. The five recommendations that have been conditionally closed are:

Recommendation 3.3-1 – Develop and implement a comprehensive inspection plan to determine the structural integrity of all Reinforced Carbon-Carbon (RCC) system components. This inspection plan should take advantage of advanced non-destructive inspection technology. To close this recommendation, NASA has cycled all Orbiter RCC Wing Leading Edge panels and nose cones through the vendor for inspection and confirmation of structural integrity.

Recommendation 4.2-3 – Require that at least two employees attend all final closeouts and intertank area hand-spraying procedures. To close this recommendation, NASA's procedures have been changed to require a minimum of two technicians be present for all final vehicle closeout operations, even with completion of critical closeout procedures during manufacturing and assembly.

Recommendation 4.2-5 – Kennedy Space Center Quality Assurance and United Space Alliance must return to the straightforward, industry-standard definition of "Foreign Object Debris," and eliminate any alternate or statistically deceptive definitions like "processing debris." To close this recommendation, NASA has ceased using the term "processing debris" and has changed all work procedures to treat all debris at the same high level.

Recommendation 6.3-2 – Modify the Memorandum of Agreement with the National Imagery and Mapping Agency [now the National Geospatial-Intelligence Agency (NGA)] to make the imaging of each Shuttle flight while on orbit a standard requirement. To close this recommendation, NASA has agreements with NGA and other government agencies to receive support using appropriate national assets.

Recommendation 10.3-1 – Develop an interim program of closeout photographs for all critical sub-systems that differ from engineering drawings. Digitize the closeout photograph system so that images are immediately available for on-orbit troubleshooting. NASA has revised the vehicle processing procedures to mandate that closeout photography be performed and has implemented enhancements to the Still Image Management System to allow more efficient distribution of closeout photographs to support on-orbit troubleshooting.

NASA has embraced the Gehman report and is committed to complying with all the Board's recommendations, as well as self-initiated "raise the bar" actions to improve safety that go above and beyond the content of the Board's recommendations. In addition to the Board's recommendations, the Space Shuttle program is working fifteen

self-imposed actions and directives. Of these “raise the bar” initiatives, the RTF Task Group has elected to review Space Shuttle Program Action 3, Contingency Shuttle Crew Support (CSCS). The CSCS capability could, in an emergency, sustain a Shuttle crew on board the ISS for a limited time to enable a repair to the Orbiter or allow the crew to be returned to Earth via a rescue mission. The Space Shuttle and ISS programs have made progress in defining and planning for a CSCS capability. The two programs have completed analyses that indicate that, for our first two flights at a minimum, it is possible to launch a rescue mission during the time that the Shuttle crew can be safely sustained on the ISS. Other “raise the bar” initiatives include review of processes, hardware and activities or analyses that we believe will make the Shuttle safer. These include analysis and testing to determine critical debris sources, improvements to the flight readiness review process, removal and refurbishment of the Orbiter rudders speed brake actuators, radar coverage capabilities and requirements, and hardware processing and operations.

We continue to make significant progress in understanding the debris environment and the material characteristics of the Orbiter and External Tank Thermal Protection System (TPS). As a result, we are able to better target critical areas for hardening prior to RTF. Even more critical to our ability to return safely to flight, we have made significant progress in reducing the foam debris that is shed from the External Tank during ascent. Work to develop viable repair techniques and materials for the Orbiter TPS is under way, and progress has been made on repairing acreage tiles and Reinforced Carbon-Carbon cracks.

As our efforts to return the Space Shuttle to safe flight have matured and the required work has been identified, NASA has gained a better understanding of the costs associated with this challenging endeavor. Along with the tasks required for RTF, we have reinvigorated our safety and engineering practices. As a result, we have continued to identify safety-related issues that require additional work. Earlier cost estimates presented in previous revisions of the Implementation Plan could not have included all RTF elements now under consideration. Nor did they address additional requirements that might be derived from our continuing evaluation of the Board’s recommendations, or costs incurred by other Agency activities in support of RTF. The current cost estimate, submitted to the Committee on July 30, takes into account all currently known potential costs, except a budget reserve. This estimate will also change to address new challenges that may arise after the first two flights in 2005.

NASA’s updated estimates for RTF activities are as follows:

FY 2003	\$42 million
FY 2004	\$465 million
FY 2005	\$643 million (includes \$309 million remaining “under review”)

NASA’s updated RTF estimates through FY 2005 are reflected in **Enclosure 1**.

The updated FY 2003 estimate of \$42 million reflects actual expenditures and the migration of planned work from FY 2003 into FY 2004. The updated FY 2004 estimate

of \$465 million reflects the continuing refinement of our RTF plan, better technical definition of the work to be accomplished, and better cost estimates for the work. Our estimates for the remaining years are based on our experience to date, which is still evolving. Through the early part of 2004, the pace of NASA's RTF technical efforts accelerated rapidly. We moved from planning to execution very quickly, and began to close on some of the multiple paths we initiated in late 2003. But there is still a great deal of work ahead, and we are still refining our technical solutions and our cost estimates. As we do and the content is better defined and understood, the budget projections will likely change again. They will also change in 2005 as we launch the Space Shuttle and assess the information gained by actual flight experience.

The Columbia experience has moved us to reassess the Space Shuttle program in total. As a result, we are introducing a higher level of engineering and technical rigor into all of our safety and engineering processes and practices. Many potential flight risks have been reevaluated and mitigated, resulting in what we believe is a safer Shuttle system overall. Across the board, flight hardware is now subjected to greater levels of test, teardown, inspection, repair, and recertification for flight, and all elements of the program are reassessing the adequacy of industrial processes, safety controls, integrated hazard analyses, and flight hardware test protocols.

When we return to flight, we believe the Space Shuttle will be safer, but we will never eliminate the risk. We are confident in our ability to maintain a renewed level of safety standard throughout the life of the Space Shuttle program. We have the best and brightest in NASA and industry working diligently to overcome the challenges of returning the Shuttle safely to flight. Although there will most likely be additional challenges before Discovery takes flight, the NASA and contractor team are confident that the Space Shuttle program can safely accomplish its role in the Vision for Space Exploration to complete International Space Station assembly. As John Kennedy so eloquently said more than forty years ago, "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard." We are committed to the safe return to flight—the first step toward the renewed NASA mission to explore the universe.

Thank you again for the opportunity to appear before you today, and I look forward to any questions that you may have.

Enclosure 1

	<u>FY 03</u>	<u>FY 04</u>	<u>FY 05</u>
<u>TOTAL RTF</u>	<u>42</u>	<u>465</u>	<u>643</u>
RTF Activities - approved/paperwork complete	31	319	117
RTF Activities - tentatively approved/paperwork outstanding	11	146	217
RTF Activities - In Review Process	0	0	309
<u>RTF Activities - Control Board Directive</u>	<u>31</u>	<u>319</u>	<u>117</u>
Orbiter RCC Inspections & Orbiter RCC-2 Shipsets Spares	2	38	0
On-orbit TPS Inspection & EVA Tile Repair	20	68	34
Orbiter TPS Hardening		28	1
Orbiter Certification / Verification		47	
Orbiter Other (GFE/Contingency)		15	16
External Tank Items (Camera, Bipod Ramp, etc.)		6	1
SRB Items (Bolt Catcher, ETA Ring Invest., Camera, other)	1	8	
Ground Camera Ascent Imagery Upgrade	8	40	3
Rudder Speed Brakes		5	11
Other (System Intgr. JBOSC Sys, Full Cost, Additional FTEs, etc.)		62	50
Return to Flight Task Group (Stafford-Covey Team)	0	3	1
<u>RTF Activities - Been to Control Board/No Directive</u>	<u>11</u>	<u>146</u>	<u>217</u>
Orbiter Workforce (Ground Ops)		5	5
External Tank Items (Camera, Bipod Ramp, etc.)	11	109	92
Ground Camera Ascent Imagery Upgrade			52
Orbiter Workforce (Ground Ops, USA, Boeing, Logistics Eng.)			32
KSC Ground Ops Workforce		32	36
	<u>FY 03</u>	<u>FY 04</u>	<u>FY 05</u>
<u>RTF Activities - In Review Process</u>	<u>0</u>	<u>0</u>	<u>309</u>
Orbiter RCC Inspections & Orbiter RCC-2 Shipsets Spares			
On-orbit TPS Inspection & EVA Tile Repair			
Orbiter TPS Hardening			
Orbiter Certification / Verification			
SRB Items (Bolt Catcher, Camera, other)			
Ground Camera Ascent Imagery Upgrade			
Increased SSME Testing			
SSME CAIB Impacts			
Other (System Intgr. JBOSC Sys, Full Cost, Additional FTEs, etc.)			